VOL. XLV, NUMBER 2 WHOLE NUMBER 389

THE JOURNAL
OF
THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

DEVOTED TO THE ADVANCEMENT OF ASTRONOMY AND ALLIED SCIENCES

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PUBLISHED BI-MONTHLY
(*Six numbers per year*)

March-April, 1951

PRINTED FOR THE SOCIETY
TORONTO: 3 WILLCOCKS ST.

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Address of Editors: David Dunlap Observatory, Richmond Hill, Ont.

Business correspondence and remittances should be addressed to J. H. Horning, Treasurer of the Society, 3 Willcocks St. Toronto.
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SOME CHARACTERISTICS OF 10.7-CENTIMETRE SOLAR NOISE, II

BY A. E. COVINGTON

Introduction.—Solar radio noise has been received on a daily basis for the years 1947 to 1950 at the laboratories of the National Research Council in Ottawa, using equipment which responds to a wave-length of 10.7 centimetres. The daily values of solar noise have been described in a previous issue of the JOURNAL (vol. 45, p. 15, 1951); the present paper (Part II) deals with a description of the solar noise bursts.

Bursts of Solar Noise.—During the period under consideration the bursts of solar noise have been correlated with the commencement of sudden ionospheric disturbances (referred to as S.I.D.), as recorded at Washington and published in the reports of the Central Radio Propagation Laboratory[6]. In such preliminary work a solar noise burst (referred to as S.N.B.) and S.I.D. are considered as related when the start of both falls within a forty-minute interval. Sometimes the radio telescope went into operation at such a time that only the decline of a solar noise burst was recorded. These incompletely recorded coincidences have been counted only if the radio fadeout preceded the switching-on time by less than twenty minutes.

The results of the comparison are shown in Table I. The solar noise bursts occur on the average one in every twenty-three hours of observation, and about sixty per cent. are associated with the radio

[6]Ionospheric Data, Series F, Central Radio Propagation Laboratory, Washington, D.C.

fadeouts. Since partial equipment failures are sometimes as frequent as the solar noise bursts, a few doubtful cases have been excluded. In general, all the significant partial failures and occasional interference from nearby radar sets can be identified by their structure. In judging the stability of the radiometer with respect to partial equipment failure, use is made of the over-night record when the antenna points towards the earth, or on some occasions when it is replaced by one of the heated resistances used for calibration. Over long periods there is considerable variation in the number of small disturbances whose intensity is only a few times the residual noise of the receiver, as well as in the residual noise itself. This irregular behaviour makes the observation of small solar disturbances unreliable, and undoubtedly a great many more small disturbances occur than have been noted. The use of two independent radiometers would be very useful in eliminating any spurious bursts.

Type Bursts.—In comparison with solar noise bursts recorded on longer wave-lengths[7,9] the ten-centimetre bursts are very simple

TABLE I

Quarters	S.N.B. Alone	S.N.B. and S.I.D.	Very Weak S.N.B. and S.I.D.	S.I.D. Alone	Hours of Observation
1947 1	2	1	0	2	80
1947 2	7	25	1	10	360
1947 3	4	9	0	5	320
1947 4	0	4	0	0	330
1948 1	0	6	1	0	360
1948 2	1	16	0	2	520
1948 3	4	11	0	0	490
1948 4	14	7	1	4	450
1949 1	20	10	3	2	410
1949 2	4	8	4	3	610
1949 3	11	25	1	10	720
1949 4	10	12	0	5	440
	77	134	11	43	5,090

[7] A. E. Covington and W. J. Medd, this JOURNAL, vol. 43, p.106, 1949.

and show regular changes. In order to illustrate the structure common to the ten-centimetre noise bursts, certain bursts and certain unusual features have been selected as typical of a class, and the frequency of occurrence has been found. Tracings of these type bursts have been made and are shown in figures 4A and 4B. Bursts *a* to *h* have been traced from the high-speed record without attempting to reproduce the residual receiver noise, since it is only two or three times the width of the recorder pen line. Bursts *i* and *j* have been made from the slow-speed record by drawing a line through the centre of the band of fluctuations which represents the receiver noise. The last record, *k*, shows a period of solar noise fluctuations of intensity comparable to the receiver noise.

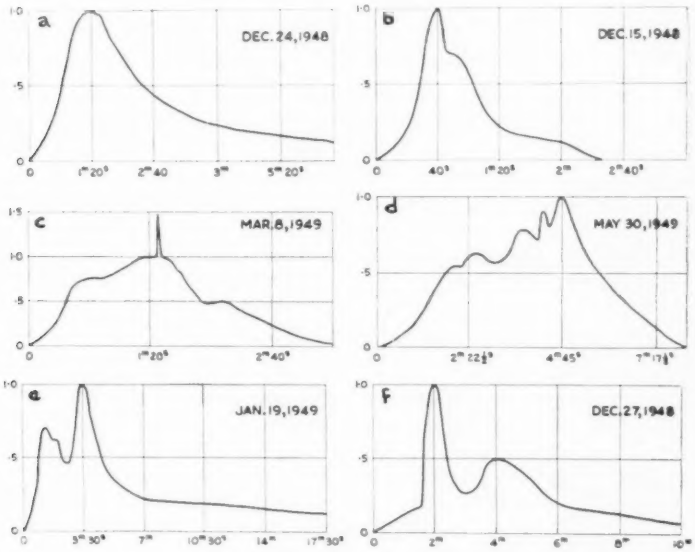

FIG. 4A.—Typical 10.7-centimetre solar noise bursts. (*a*) Simple burst with post-burst increase (intensity 350°K.); (*b*) simple burst with secondary maximum just evident (intensity 145°K.); (*c*) simple burst with fluctuations and superimposed burst (intensity smooth 125°K.); (*d*) simple burst with fluctuations on leading edge (intensity 205°K.); (*e*) complex burst with post-burst increase (intensity 165°K.); (*f*) complex burst with precursor and post-burst increase (intensity 155°K.).

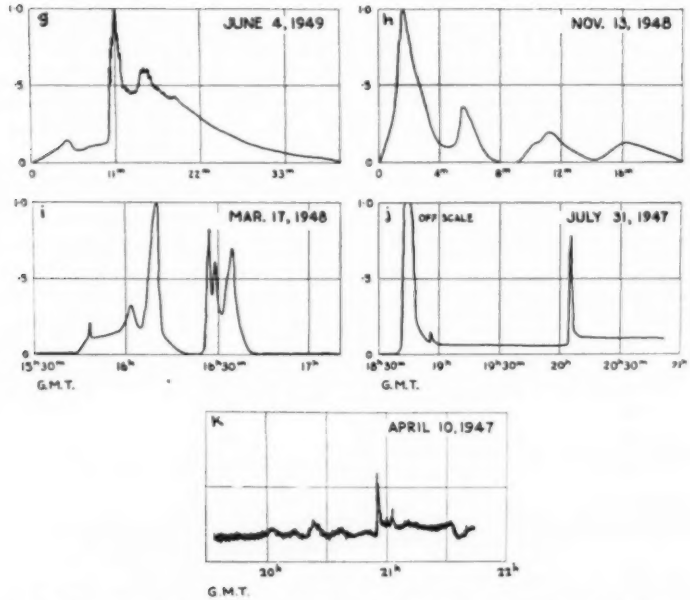

FIG. 4B.—Typical 10.7-centimetre solar noise bursts, continued. (*g*) Complex burst with precursor and fine fluctuations during peak (intensity 640°K.); (*h*) group of two complex bursts (intensity 230°K.); (*i*) group of two complex bursts (intensity 150°K.); (*j*) off-scale burst (intensity >645°K.) with superimposed burst and post-burst increase followed by a simple burst with post-burst increase; (*k*) extended period of irregular activity showing the band of receiver noise (peak intensity 125°K.).

Small Fluctuations.—The records taken with the paper moving at high speed sometimes show fluctuations of small intensity, with periods ranging from the smallest observable (of the order of one second), up to several minutes. Since these fluctuations generally do not affect the main trend of the burst variation, they are to be disregarded in the classification of bursts. Small fluctuations were recorded during the decline of the burst of August 1, 1949 (see figure 5). At 15^h21^m E.S.T. there is a small increase of solar noise superimposed on the gradual decline, while at 15^h22^m there is a fluctuation of an entirely different nature. The noise first decreases

and then increases in what appears to be a highly damped oscillation. This structure is then repeated several times with diminishing intensity. In addition to these well defined variations there is a rapid irregular fluctuation which has smeared the pen trace into a

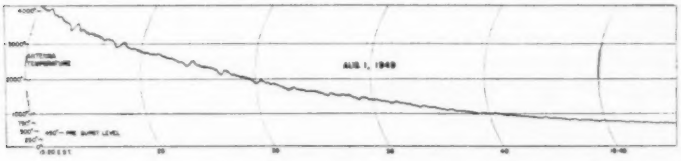

FIG. 5.—Exponential decline of large burst showing superimposed small fluctuations.

broad band. This roughness in the recorded line should be compared with the smooth pen trace at the end of the burst when only the radiometer noise is present. The damped oscillations have been recorded only once, and are the only example of a decrease of solar noise which appears to be associated with an absorption rather than with a decay of activity. The continuous type of irregular fluctuation is evident in about one-third of the bursts; sometimes it appears only during the rising phase, or only during the decline, while at other times it is present during the peak period, as is indicated by the broadened line in example *g*. A large open fluctuation is shown in example *d*.

Simple and Complex Bursts.—The single bursts which show a gradual rise and fall of intensity have been termed *simple* in contrast to the single bursts which show two or more maxima before the activity has declined to zero; the latter are termed *complex*. It is remarkable that eighty per cent. of the complex bursts show only two maxima. The average number of maxima is 2.1, and the maximum number of peaks observed in one burst is four. The complex type is perhaps suggestive that there are several regions of activity, or that the same region is experiencing another period of activation. From consideration of burst duration, the first suggestion appears likely when a burst of very short duration is superimposed upon a longer burst (see examples *c* and *j*). Because of the relative ease with which the short duration bursts are separated from the main trend they are not considered in the classification of bursts into *simple* and *complex* forms, but are considered separately as

superimposed bursts. The intensity is usually smaller than that of the main burst. The maxima in the complex form present a wide range of comparative intensity, ranging from a minor peak just evident above the smooth level (example *b*) to almost separated components. When such a minor peak shows an intensity above the general trend of less than one-fifth the main peak, the burst is considered as simple, and the peak is regarded as a fluctuation. The maxima in the complex form show comparable duration: about sixty per cent. of the complex bursts have maxima of the same duration; thirty per cent. have maxima which are one-half as long, and ten per cent. have maxima which are one-third as long. In estimating these ratios most consideration was given to the duration of the maxima near the peak values, in order to separate the maxima from the background variation.

The simple bursts present minor variations amongst themselves, and undoubtedly when more material is available separate subclasses may be formed. For example, the very simple type shown in *a*, and the type shown in *d* together with its fluctuations, are identical with other bursts that have been recorded. Similarly the form of burst *b* has appeared several times, and is a border-line case between the true simple and the complex bursts.

Groups.—Single bursts occasionally occur one after the other to form a group (see examples *h* and *i*). In a group, the intensity between elements is the same as the daily value, and the duration is less than three times the longest single bursts. The constituent bursts may be either simple or complex, and the average number of elements in a group is 2.2. Sometimes many small bursts whose intensity is a few times that of residual receiver noise occur in succession to present a moderately disturbed period, such as shown in example *k*.

Precursor and Post-burst Increase.—Occasionally the post-burst level is greater than the pre-burst level, and a long time, ranging from fifteen minutes to several hours, is required for the return to normal. In this case the long return to normal is not considered in determining the duration of the burst. A gradual increase in the solar noise sometimes precedes the rapid increase which is so characteristic of the burst and is termed a *precursor*. Its duration is not included in the burst duration. Sometimes a precursor and a post-burst increase occur together and give the impression that the

burst is superimposed on another smaller burst of greater duration (see example *f*).

The start of a burst is taken at the tangential rise when the deviation from a general calm level is of the order of set noise. This is usually taken from a high-speed record and can be determined within fifteen seconds. The end of a burst occurs when the level has returned to the general trend for the day, and is determined within a minute or sometimes several minutes. The peak intensity of the burst is the increase above the general daily level expressed in terms of the antenna temperature, or in watts/square metre/cycle per second.

It has been noticed that the maxima of a complex burst can be seen on the low-speed record as well as on the high-speed record. Since the high-speed records are available for only half of the three-year period, this observation conveniently allows all the material to be used. The detection of fluctuations and superimposed bursts cannot always be resolved from the low-speed record, and so the frequency of these phenomena was taken from the smaller set of high-speed records. The frequency of occurrence of the various types of phenomena is shown in Table II. Information for Part A was taken from all the records, while only the high-speed traces were used for Part B.

Relationship with other Phenomena.—The relationship between the commencement of the S.I.D., as shown by the Washington data,

TABLE II

PART A

Bursts with commencement not recorded	11
Bursts off-scale	19
Bursts with superimposed radiometer disturbances	5
Burst intensity few times residual noise	64
Simple bursts (Average number of maxima .. 1.0)	60
Complex bursts (Average number of maxima .. 2.1)	37
Groups of single bursts (Average number of bursts .. 2.2)	20
Periods of irregular activity	6
Total	222

PART B

	Pre-cursor	Post-burst Increase	Precursor and Post-burst Increase	Super-imposed Burst	Fluctu-ations	Super-imposed Burst + Fluct'ns	Number of Bursts
Simple Bursts	0	17	4	7	8	1	37
Complex Bursts	3	7	2	8	3	2	25

and the commencement of the simple and complex bursts is shown precisely by the histogram in figure 6. The beginning of the burst precedes the radio disturbance by about two minutes on the average, and most of the bursts are contained within a six-minute interval. In giving significance to the lead of two minutes, one must keep in mind that the variations in measuring the start of the radio fadeout are of comparable order. During the last sunspot maximum, Newton and Barton[8] found that the average flare preceded the radio fadeout by a period of four minutes, so one can conclude that, in general, the average ten-centimetre solar noise

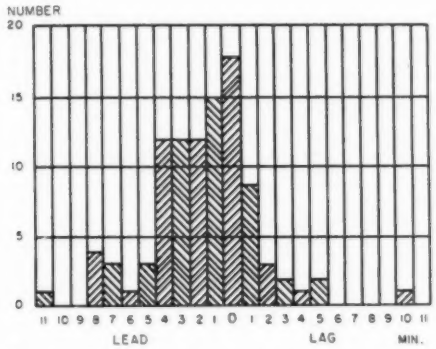

FIG. 6.—Time difference in minutes that solar noise burst precedes the start of radio fadeout.

[8]H. W. Newton and H. J. Barton, *Roy. Ast. Soc., Mon. Not.*, vol. 97, p.594, 1937.

burst starts with the chromospheric eruption. This is to be compared with the behaviour of the longer wave-length bursts which, in general, are delayed after the commencement of the radio fadeouts. On a wave-length of 4.1 metres Hey, Parsons and Phillips [9] found that the radio noise was delayed 13.5 minutes after the radio fadeout.

Fortunately data are available for the solar disturbance of July 31, 1947, and a detailed comparison of the solar flare (see Dodson and Hedeman[10]), the 4.1–metre radiation (see Hey, Parsons and Phillips[9], figure 2), and the 10.7–centimetre radiation (example *j*, figure 4B) can be made. The longer wave-length burst coincides with a small 10.7–centimetre burst superimposed on the decline of the main outburst. Similarly, on December 27, 1948, a 200-megacycle burst recorded at Ottawa appeared simultaneously with the second maximum of the ten-centimetre noise burst (example *f*, figure 4A). The few other 200-megacycle records taken at Ottawa show no other examples of this interesting type of coincidence.

Relationship between Burst Duration and Intensity.—All the bursts—single, simple, complex, and those with an intensity a few times the receiver noise—have been entered into the appropriate cell on a chart which has co-ordinates of burst intensity and burst duration (see figure 7A). In order to accommodate the somewhat wide range of values found, logarithmic scales have been used for the co-ordinates. Most of the off-scale bursts have been entered, since in general it has been possible to estimate a value for the peak intensity. The total number of bursts entered is 169. Bursts which are associated with an S.I.D. are indicated as a cross, while those which are not associated with an S.I.D. are entered as a dot. This shows at once that every intense burst is associated with a radio fadeout and consequently with a solar flare. On the other hand only a few of the weak bursts show an association with a radio fadeout. The scatter and density of points is such as to indicate a tendency for the log. of the burst duration, D, to be proportional to the log. of the burst intensity, I, ($\log D = \log \text{const } K + m \log I$). The correlation coefficient between $\log D$ and $\log I$ is 0.4, and m is equal to 0.3. The simple and complex bursts have been plotted

[9]J. S. Hey, S. J. Parsons and J. W. Phillips, *Roy. Ast. Soc., Mon. Not.*, vol. 108, p. 354, 1948.

[10]Helen W. Dodson and E. Ruth Hedeman, *Astrophys. J.*, vol. 110, p.242, 1949.

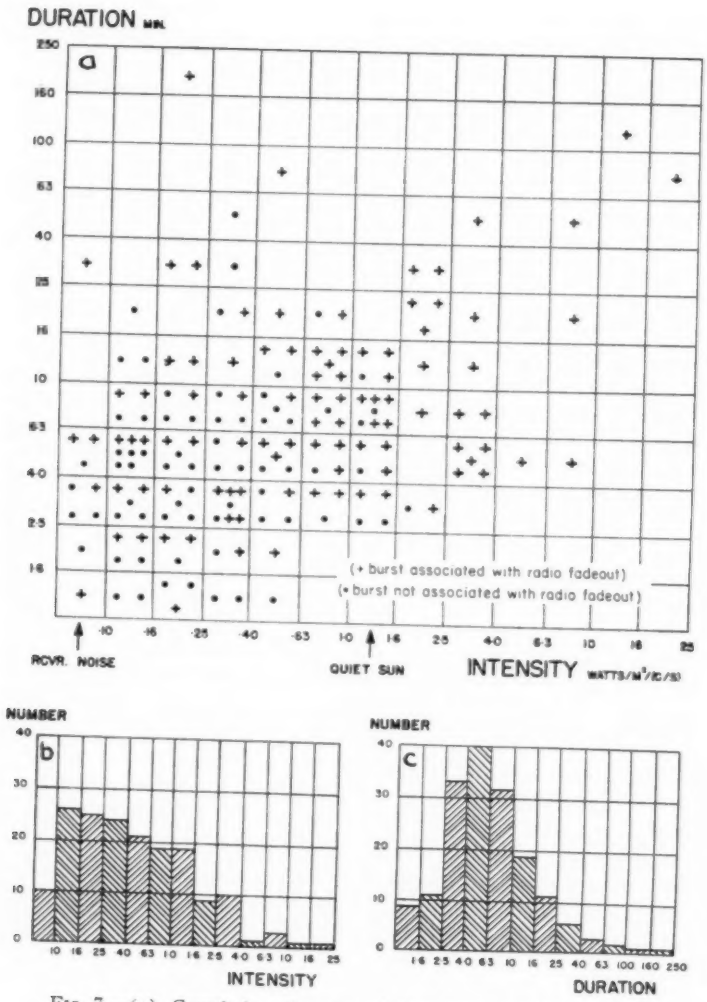

FIG. 7.—(*a*) Correlation diagram relating burst duration and burst intensity; (*b*) distribution of burst intensities; (*c*) distribution of burst durations.

together, since there was little apparent difference in the separate scatter diagrams. As previously mentioned, because of receiver instability, there may be a lack in the number of bursts whose intensity is a few times that of residual noise. The very intense burst of April 15, 1947, has not been entered on this scatter diagram, since the duration is greater than four hours, and the intensity greater than 50×10^{-20} watts/square metre/cycles per second. Although this burst is the largest on record, it does not seem out of place in relation to the trend shown in the scatter diagram of figure 7a. This same material, plotted in figures 7b and 7c, reveals that the most frequent burst intensity is from 1/10 to 1/2 that of the quiet sun (60,000°K.), and that the most frequent burst duration is about five minutes.

Burst Structure.—Attempts have been made to fit analytical curves to the bursts. As a first approximation it is noticed that all the bursts possess an asymmetry, indicating a sudden rise and gradual fall. In the simple bursts this asymmetry can be measured by the ratio ρ of the rise time to the duration of the burst. Scatter diagrams show that this ratio is approximately independent of burst duration and intensity, and that the most frequent value of ρ is 0.3 (see figure 8).

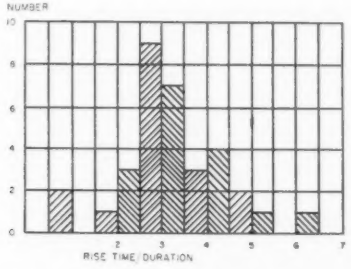

FIG. 8.—Distribution of the ratio of rise time to burst duration for simple bursts.

The decline of the more intense bursts which have been recorded on the high-speed chart has been plotted on semi-log. paper. In this group of simple, complex and off-scale bursts, a straight line indicating an exponential decline can be fitted fairly well to one-

half of the bursts. Many of the bursts such as the one which occurred on August 1, 1949 (see figure 5), give a very close fit. The exponential decay includes at least 75 per cent. of the burst decline. There appears to be a tendency, as shown in Table III, for the long

TABLE III

Complex bursts not fitted				4
Bursts with gradually changing decay rate				11
	Time Constant (minutes)	Intensity (w./m².c.s. × 10^{-20})	No. of Bursts	
Bursts with exponential decay	.5– 1	1.1	5	19
	1– 2	2.4	6	
	2– 4	0.8	4	
	4– 8	10.4	2	
	8–12	13.0	2	
Bursts with two different exponential decays				2
Total number of bursts				36

time constants to be associated with the more intense bursts. In addition to the group of exponential decays there are eleven bursts with a gradually changing decay rate. Nine of these show a smooth increase in the instantaneous time constant, while the remaining two show a smooth decrease. Only two bursts occurred which show two definite decay rates, although those bursts with a post-burst increase (figure 1) might be considered to exhibit this phenomenon.

Errors.—The main sources of error in finding the intensity of the solar noise are in the determination of the antenna gain and of the sky temperature. The error in the determination of antenna gain may be about ±5 per cent. The preliminary observations of a sky temperature of 50°K. seem too high in view of later observations, and if a lower value of 10°K. is used, then all the solar noise readings will be increased systematically by about 15 per cent. The present method of maintaining the radiometers in operation permits the solar noise intensity to be measured with a relative accuracy of ±5 per cent.

Long Term Variability.—During the years 1947 to 1950 a steady decline in the 10.7-centimetre solar radio noise is revealed in the daily values of the antenna equivalent temperature (figure 3, part

I, and figure 9, part II) and coincides with the decline of solar activity as shown by other indices such as the appearance of sun-spots. The radio emission from sun-spots is shown by the amplitude of the fluctuations and this amplitude has declined from a peak range of variation of 600° in 1947 to a low value of 100° at the end of 1950. The radio emission from the quiet sun as shown by

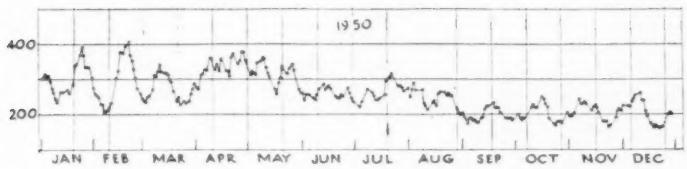

FIG. 9.—Daily values of 10.7-centimetre solar noise for 1950.

the lower envelope has declined from 290° in 1947 to a value of 160° at the end of 1950. The solar radio emission at 10.7 centimetres is variable and it appears that the sun may be regarded as a variable star. Van de Hulst[11] has shown that the electron density in the solar corona varies by a factor of 1.7 during the eleven-year sun-spot cycle and has estimated that the maximum variability of radio waves from the sun should occur in the wave-length range 25 to 100 centimetres with a maximum at wave-lengths near 50 centimetres, and that the brightness variation of the quiet sun should oscillate by a factor of 2. The factor 1.8 given by the present series of observations on a wave-length of 10.7 centimetres is at least a minimum indication of the brightness variation to be observed from the sun during the sun-spot cycle.

National Research Council,
Ottawa.

[11]H. C. van de Hulst, *Nature*, vol. 163, p.24, 1949.

MINUTES OF THE ANNUAL MEETING OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

The sixty-first annual meeting was held in the McLennan Laboratory of the University of Toronto on Friday, January 12, 1951. The Second Vice-President, Dr. J. F. Heard, occupied the chair, in the absence of the President.

Before discussing any business matters at this meeting, the following resolution of appreciation of the late Dr. Frank S. Hogg was moved by Mr. A. R. Clute, Retiring President of Toronto Centre, seconded by Mr. W. J. McCallion, President of Hamilton Centre, and carried:

BE IT RESOLVED:

That the Royal Astronomical Society of Canada express its deep regret at the untimely death on New Year's Day, of one of its most valued members, Dr. Frank Scott Hogg.

Dr. Hogg was a native of Preston, Ontario, a graduate of the University of Toronto and an A.M. and Ph.D. of Harvard University. He had continued his studies of astronomy for a year at Cambridge and other European Universities. Even before launching on his professional career, he had made important contributions in the fields of spectrophotometry and cometary spectroscopy. His professional appointments included positions at Amherst College, the Dominion Astrophysical Observatory, and finally at the University of Toronto, where he rose from Lecturer in 1935 to Head of the Department and Director of the David Dunlap Observatory in 1946.

Dr. Hogg's association with this Society has been long and varied. In 1926 he was the recipient of the Society's Gold Medal upon graduation from the University. From 1937 until the time of his death he was the Assistant Editor of the JOURNAL. In this capacity he accepted more and more responsibility, and, that he put his utmost into this work, is attested by the high place which this JOURNAL holds among astronomical publications. From 1941 to 1943 he was President of the Society. Not only then but always he played a most active part; indeed, during some of the Society's most difficult days his wisdom and his realistic approach to what appeared to be insurmountable problems contributed to the Society's salvation.

That Dr. Hogg will be missed among us for his scholarship, his leadership, his wit, but most of all for the kindly encouragement which he conveyed to all who tried to understand, in some measure, the things he understood better than any of us.

That the Society extend to Dr. Helen Hogg and to their children, its most sincere sympathy.

As a token of respect for the late Dr. Hogg, the members present stood in silence for one minute.

Moved by Mr. E. J. A. Kennedy, seconded by Mr. J. H. Horn-

ing, that in the absence of the Recorder, Mr. H. W. Barker, due to illness, the undersigned act as Recorder, pro tem.

Moved by Mr. F. L. Troyer, seconded by Mr. Horning, and approved by members present, that the Minutes of the Annual General Meeting of January 9, 1950, be taken as printed in the JOURNAL, March-April, 1950.

For the purpose of counting the ballots returned by mail, Mrs. E. Todd, Assistant Secretary, and Mr. W. R. Sherrick, were appointed scrutineers.

The National Treasurer, National Secretary and Librarian presented their reports. These appear in the JOURNAL. Owing to the sudden death of the Assistant Editor, Dr. Frank S. Hogg, no Editor's Report was presented.

In response to a letter received from Ottawa Centre, the following resolution was moved by Dr. R. E. Williamson, seconded by Mr. A. R. Clute, and carried:

> That this Society go on record as urging the Canadian Government to designate the area involving the recently explored crater in Ungava as a National Park, or to take other appropriate steps to preserve this crater as an object of scientific interest and that the National Council be asked to take the necessary steps for action.

The advantage of purchasing another astronomical film for use in the Centres of the Society was discussed. It was moved by Mr. Kennedy, seconded by Dr. Best, that the Librarian see what films are available and report to the National Council.

The report of the scrutineers showed that the printed list of Officers and Council was approved. The names appear elsewhere in this JOURNAL. Three hundred and twenty-five ballots were cast, all but six being favourable to the printed slate.

Miss Northcott moved, seconded by Mr. Sherrick, a vote of thanks to all the Members of Council for their devotion to the interests of the Society during the year. (Carried.)

Moved by Mr. Kennedy, seconded by Mr. Troyer, that the Society's best wishes be conveyed to Mr. Barker for his speedy recovery and to Mrs. Barker for her anxiety on account of her husband's illness. (Carried.)

The thanks of the Society was expressed to Dr. Best and Mr. J. R. Collins for their support in acting as trustees.

The meeting was adjourned.

F. KEITH DALTON, *Recorder, pro tem.*

Report of the National Secretary

The year 1950 is the sixtieth since the incorporation of the Society—our Diamond Jubilee. It is interesting to read the purposes and aims as expressed by the handful of astronomical enthusiasts who met in 1890 and who set out in the constitution the following: "To study astronomy, astrophysics and such cognate subjects as shall tend to the better consideration and education of astronomical and astrophysical problems and to diffuse the theoretical and practical information with respect to such subjects." We aim to introduce to our audiences a most entrancing subject and to show them the pleasures of an acquaintance with the wonders of the heavens; also by observation and study to contribute in a greater or less degree to our knowledge of the science of astronomy. These aims have been splendidly maintained through the years until now it can be said that the Society exercises an important educative and cultural influence through its fourteen centres across Canada.

Although the great body of our membership is amateur we are proud to number among our members all the professional astronomers in Canada and many elsewhere. To them we acknowledge with gratitude the generous support and assistance they render to the Society, particularly in the purely voluntary and arduous task in connection with preparing and editing our publication.

It is with much sorrow that I have to record the passing of Dr. Frank S. Hogg, Past President and Assistant Editor. While those of us at headquarters think of it as an almost irreparable loss to the Society, in addition we also feel it a great personal loss. Possessing a brilliant mind Dr. Hogg combined great charm of manner and an unfailing sense of humour which endeared him to all. In our executive meetings we relied much on his wise counsel. The sudden announcement of his death came as a great shock to us because so few suspected his physical weakness. It is all the more tragic since he had not reached the peak of his capacity and attainments. In the circumstances it is amazing the amount of work he undertook and accomplished aside from his heavy programme of astronomical research. He will be sadly missed as an able administrator and helpful friend.

Interest in the Chant Medal award is keen. The committee has adjudged Mr. F. Keith Dalton, B.A.Sc., E.E., of the Toronto

Centre, the winner for 1950. A summary of the activities of Mr. Dalton in the field of amateur astronomy follows.

Mr. Dalton is a supervising engineer for the Hydro-Electric Power Commission of Ontario, and includes astronomy among his active hobbies. He has reported careful observations of the planets and of eclipses of the sun and moon. He has made original additions to his telescope: he applied a sun-dial and declination head so that Venus and Mercury could be found readily in the daytime; he made a polarizing-type of eyepiece, by which the background sky is darkened so that Polaris could be found more easily in the daytime; he designed and built erecting star diagonals, erecting solar diagonals and diagonal eyepieces for finder telescopes. Recently he has undertaken research on the study of the microhardness of meteorites; this has been done in collaboration with members of the staff of the American Meteorite Museum, who supplied the samples, and the Canadian Westinghouse Company Limited, in whose laboratories the testing was done. This is, perhaps, the most extensive investigation ever carried out on this aspect of meteorites. These various phases of Mr. Dalton's work have been published from time to time in this JOURNAL.

Mr. Dalton has taken an active part in the Centre, having been a member of council in 1947 and 1948 and recorder in 1949. He prepared a course of study in astronomy for the use of the Boy Scouts and Girl Guides. He has done a great deal to bring astronomy to the public, by lectures and by entertaining groups of visitors with his telescope.

During last November our energetic President, Mr. Andrew Thomson, on one of his trips to the Pacific coast, took the opportunity of visiting the five western Centres from Winnipeg to Victoria. His discussions with the officers, which he has reported to the Council, will be most helpful. He also met some members of the Regina Astronomical Club. This is a small group which we hope will eventually establish a Centre in Regina. We recognize the handicap of distance preventing more frequent intercourse with our western Centres, which would be mutually agreeable and further the ends of the Society.

The members will find interesting reading in the reports of the Centres since they definitely report considerable progress. Montreal as usual reports a long list of important observations. Their Observatory at Ville-Marie is of great assistance to them in their varied observation programme. The Ottawa Centre specializes on meteoric observation under direction of Dr. Peter Millman. You will also note that Toronto has a very enthusiastic group in telescope making.

Some Centres have established libraries which are being used extensively. We remind those Centres which are not yet fortunate

enough to have one of their own, that the books of the Library of the National Council are available on loan. We would urge the newer Centres to make use of this privilege.

The standing committee on Honorary Membership made its report to the Council. The recommendation was that we should invite Dr. Edwin P. Hubble, Ph.D., LL.D., Mount Wilson Observatory, and Prof. H. H. Plaskett, F.R.S., M.A., Savilian Professor of Astronomy, Oxford. The Constitution provides that two members may be added each year.

Dr. Hubble and Prof. Plaskett were informed of the desire that they should accept Honorary Membership in the Society and they replied as follows:—

From DR. HUBBLE:

Please convey to the National Council of the Royal Astronomical Society of Canada my deep appreciation of their proposal to nominate me for consideration as an Honorary Fellow.

If elected, I would accept the honor with pleasure and pride.

From PROF. PLASKETT:

I am indeed greatly honoured by the proposal of the National Council to nominate me as an Honorary Member of the Royal Astronomical Society of Canada. In view of the close association of my father with the Society over a period of many years and the fact that my first scientific paper was published in the JOURNAL, you will realize that few astronomical honours could give me greater pleasure than this.

In our report of last year it was mentioned that the Council had prepared a brief for presentation to the recently appointed Royal Commission to enquire into the cultural development of the arts and sciences in Canada. This brief was presented by Mr. Andrew Thomson and Dr. Beals when the Commission met in Ottawa during March. As the Commission has not yet presented their findings the result is still in abeyance.

The Secretary's office appreciates the co-operation of the Secretaries of the Centres in making their reports.

The membership figures are given separately. The policy of eliminating past-due members from the list indicates that only those who are active members are recorded. The popularity of the Observer's Handbook is continuing.

MEMBERSHIP ON DECEMBER 31, 1950

	1949	1950	Eliminated
Toronto	367	352	39
Ottawa	70	86	8
Hamilton	49	55	1
Winnipeg	34	27	11
Victoria	110	96	25
Montreal	266	254	—
London	40	37	—
Vancouver	36	40	12
Edmonton	53	48	19
Quebec	63	56	—
Windsor	49	44	14
Saskatoon	26	14	11
Guelph	33	14	16
Centre français de Montréal	58	43	17
Canada	66	58	12
U.S.A.	327	281	51
Other Countries	32	26	5
Life Members	32	33	—
Subscribers	104	101	6
U. of T. Library	50	50	—
	1865	1715	247

E. J. A. KENNEDY, *National Secretary.*

REPORT OF THE LIBRARIAN

During the year 1950 periodicals were sent in exchange to:

Canada and the Empire	37
U.S.A.	45
Other countries	38
	120

The number of books lent from the shelves during 1950 was 95.

Members interested in meteors will wish to see the new book recently purchased by the Society: "The Nininger Collection of Meteorites." It contains a wide list of known meteorites with much information and with many photographs and drawings.

We receive regularly, chiefly from the Empire and America, in exchange for our own publications, 120 publications of other societies and institutions of learning. These are available in the reading room where members may look them over and may be taken out on loan for limited periods.

D. W. Best, *Librarian.*

REPORTS OF SECRETARIES OF CENTRES

Toronto Centre

Twelve regular meetings were held during 1950, including a joint meeting with the Royal Canadian Institute and the annual Members' Night at the David Dunlap Observatory. The Council held one meeting to appoint committees, and these committees and the executive met on numerous occasions to conduct the routine business of the Centre. In addition to four Summer Star Nights arranged on the University of Toronto campus, two additional telescope nights were held in Fairbank Memorial Park in suburban York Township.

Our annual nightly telescope display at the Canadian National Exhibition was seriously affected this year by inclement weather. Telescopes were set out, however, on seven of the fourteen nights of the Exhibition and nearly 4,000 visitors were able to view the skies. These visitors, and also another 1,000 who came around on the cloudy nights, were given complimentary copies of our "Sky Facts" leaflet. The Centre wishes to thank those members who aided by lending their telescopes or by operating them at the Star Nights and the Exhibition. In particular the Centre is grateful to Mr. W. R. Sherrick whose loan of a public-address system went far toward making our Exhibition display the success it was. Through the continued kind co-operation of the Toronto Star Limited in taking advertising space on the back page, we again were able to have a supply of a revised edition of "Sky Facts" printed for distribution at the Star Nights and C.N.E.

The Telescope Makers' Group held 12 regular meetings during 1950 at which problems were discussed and mirrors in progress

were tested. Membership in the group stood at 63 at the end of the year. The three-inch refractor presented to the Centre by Mr. George T. Dale was in almost continuous use during the year, either on loan to members or at outdoor meetings.

The Centre learned with deep regret of the passing on January 13 of Mrs. Mary Wade, a member of the Society since 1921 and a life member since 1926, and also of the death on May 9 of Mr. O. S. James, a member since 1925.

The complete list of meetings (held in the McLennan Physics Laboratory of the University of Toronto except where otherwise noted) follows:

February 7,—J. Tuzo Wilson: "Earth, The Water Planet."
February 21,—Members' Night. Gordon Hepburn: "Sundials, Sextants and Astrolabes"; Charles Crook: "The Observer's Handbook."
March 7,—Martin Schwarzschild, Princeton University: "Storms on the Stars."
March 21,—Members' Night. F. L. Troyer: "An Advance Look at the Spring Sky."
Tuesday, April 4,—John F. Heard: "The Earth as an Astronomical Body."
April 18,—Members' Night. J. F. Heard, R. L. Baglow: "Book Reviews."
May 26, June 23, July 21 and August 18,—Star Nights with telescopes on University of Toronto campus.
June 27 and July 18,—Telescope Nights in Fairbank Memorial Park, York Township.
October 17,—Annual Members' Night at the David Dunlap Observatory, Richmond Hill.
October 31,—John Galt: "Where the Dip Needle Stands on End."
November 14,—Members' Night. Raymond E. Pearce, Miss Barbara Creeper, and Kurt A. Frenkel: "The Autumn and Winter Sky."
November 28,—Gerhard Herzberg, National Research Council of Canada: "The Atmospheres of the Planets."
December 12,—William R. Hossack: "Astronomy Picture Book." Followed by the Annual Meeting of the Centre.
December 16,—John F. Heard: "Signposts in the Stratosphere—The Story of Air Navigation." (A joint meeting in Convocation Hall, University of Toronto, with The Royal Canadian Institute.)

FREDERICK L. TROYER, *Secretary.*

OTTAWA CENTRE

During the past year, four Council meetings were held to arrange the public meetings and to conduct other business of the Centre. Ten new members were welcomed; the membership now standing at eighty-six.

Seven public meetings and one meeting for members and their friends were held.

January 23,—Dr. E. A. Hodgson: "Down Under in New Zealand."
February 6,—J. A. Rottenberg: "The Origin of the Solar System."
February 20,—L. E. Howlett: "Some Canadian Contributions to Physics."
March 6,—Professor J. S. Foster: "Nuclear Physics at McGill."
March 20,—Discussion panel on meteoric astronomy. F. W. Matley: "Visual Meteor Observing"; S. A. Mott: "Fireballs"; T. L. Tanton: "Types of Meteorites"; and D. A. MacLulich: "Meteor Craters."
May 26,—"Open House" at the Dominion Observatory. At the close of the evening refreshments were served.
October 20,—J. L. Locke: "Recent News about our Sun."
November 20,—J. M. Leaver: "Weather Proverbs—Fact or Fancy."

During the year Miss M. A. McKee was appointed assistant-secretary by the Council. Miss McKee's appointment was a great help and it was a real loss when she left Ottawa the end of October.

CAROLINE B. HICKS, *Secretary*.

HAMILTON CENTRE

During the year 1950, eight regular meetings were held in Room H 102, Hamilton Hall, McMaster University, one field night and two Council meetings to discuss the business of the Centre.

January 5,—H. B. deFox: "Comets"; Rev. E. F. Maunsell: "Aurora Borealis"; A. E. Johns: A demonstration of the Planetarium. This Planetarium is the result of a campaign which was generously supported by the whole society.
February 2,—W. J. McCallion: "Twinkle, twinkle little star"; A. E. Johns: "The Constellations," with the aid of the Planetarium.
March 2,—H. W. Seekins: "Amateur Star Photography."
April 6,—W. W. Judd: "Weather Forecasting for Airways."
May 4,—Truman M. Norton: "Summing up the Galactic System"; Martin Johns: A demonstration of the Planetarium.
May 22,—Field Night on the grounds of McMaster University. Telescopes were set up behind the Drill Hall. Moving pictures were shown in Hamilton Hall. Demonstrations of the Planetarium were continuous throughout the evening. The charge for admission was 35 cents.
October 3,—A. E. Johns: "Descriptive Astronomy." The first lecture of this evening course was given October 3 and continued every Tuesday at 7.30 p.m., in the University Hall until December 19.
October 5,—Martin Johns: "Laws of Gravitation, the Study of Optics, and Radiation and their Laws."

November 2,—F. K. Dalton: "The experiments of an Amateur Astronomer"; W. S. Mallory: "The Observer's Handbook."
December 7,—H. S. Armstrong: "Minerals in Early History"; W. D. Stewart, B.A.: "Evidence of the Sphericity of the Earth."

The total membership is 57 and includes two life members.

GEORGE MURCHIE, *Secretary-Treasurer.*

WINNIPEG CENTRE

In the course of the year, seven regular meetings were held. Because of the flood last spring, plans for the regular meeting in May and the Observation Night had to be abandoned. Much new knowledge was diffused among the members and friends through lectures by capable speakers, and through films and scientific demonstrations dealing with astronomical and allied subjects.

Although the Society's plan for an observatory was not successful, new ways and means have been explored and considerable progress has been made. This goal is being pursued with vigour.

The Society suffered a misfortune in the passing away of two of its prominent members, the late Mr. G. Morse and Mr. A. V. Thomas. Both were active members and their loss is keenly felt.

Telescope making is becoming popular in this Centre and President E. R. Gardner is planning an optical shop to be at the disposal of its members.

The topics dealt with at the regular meetings were as follows:

January 11,—H. E. Rasmussen: "Time and Its Measurement."
February 8,—B. Noonan: "Spherical Astronomy."
March 8,—B. Noonan: "Glass and Astronomy."
April 12,—H. E. Rasmussen: "Astrophysics."
October 11,—E. R. Gardner: "How to Make a Telescope."
November 8,—L. T. S. Norris-Elye: "A Brief Discussion on Meteorites."
December 13,—H. E. Rasmussen: "The Challenge of the Ruled Grating."
The following films were shown: "Star Identification," "Nautical Astronomy," "The Earth in Motion," "The Solar Family."

These interesting lectures augmented by films and general discussions on astronomy provided a diversified programme which held the interest of the membership and added to the general knowledge of this Centre.

J. A. WHITE, *Secretary.*

Victoria Centre

During the year six meetings of the Society have been held. Last spring, we invited Dr. Opechowsky, Professor of Physics at U.B.C., to speak to us on "The Fundamental Particles of Nature." This lecture was very well received. Our opening meeting this fall was also very successful. We were able to obtain the technicolor movie, "The Story of Palomar," and many of our members and friends enjoyed this film.

The summer course was attended by 136 people who showed great interest in astronomy. Fourteen members of the summer course have become members of Victoria Centre. A profit of $38.60 was realized.

Membership in the Centre now stands at 106 members with 16 more becoming members on January 1, 1951. Of this number six are junior members and four are life members.

In June the National Council ruled that all members who were six months delinquent in their dues were automatically off the mailing list. This explains the decrease in membership over last year. However, we hope that many of these members who are now not receiving their Journals will soon note their loss and take the necessary action to be reinstated.

(Mrs.) J. H. Williams, *Secretary-Treasurer.*

Montreal Centre

The year 1949-50 was a very active and successful one. In addition to observation activities, Star Night, etc., fourteen general meetings of the Centre were held, with an average attendance of 78. Through the continued co-operation of McGill University and our friend and fellow member, Dr. A. N. Shaw, and his staff, the Centre still enjoys the use of the Macdonald Physics Building for its regular meetings.

The Centre was favoured with addresses from the following professional workers: Dr. G. Herzberg, Dr. J. F. Heard, W./C. Kenneth McClure, and also Mr. Russell Peterson.

A series of five lectures on the solar system was presented by members of the Council. At the annual meeting moving pictures on astronomical subjects were shown and another meeting was

held at the Montreal High School for the purpose of showing the Planetarium in action. The final meeting consisted of an interesting symposium of nine five-minute talks in which members described their own experiences in actual observational programmes.

HENRY F. HALL, *Secretary.*

REPORT OF THE LIBRARIAN, MONTREAL CENTRE

Extensive use was made of the library during the current year; up-to-date material being available not only of a general nature, but also in a number of specialized fields, such as: telescope making, astronomical photography, spectroscopy, lunar crater origins. The following books, pamphlets and periodicals were added to the library during the year:

By purchase—

The Conquest of Space: Willy Ley
Measuring Our Universe: O. Justin Lee
A Manual of Spectroscopy: I. Cutting
Skyshooting: Mayall and Mayall
The Universe and Dr. Einstein: Lincoln Barnett
The Planet Mars: Gerard de VauCouleurs
The Story of our Calendar: Ruth Brindze

Presented to the Library—

Variable Stars: Cecilia and Sergei Gaposchkin
The British Nautical Almanac
The Nature of the Universe: Fred Hoyle
Contributions from Dominion Observatory, vol. 2, nos. 3, 5, 7, and Reprint no. 45
Publications of Dominion Observatory, vol. XI, no. 8.

Binding—

R.A.S.C. Journal for 1949
Binders (2) for Volumes 8 and 9—Sky and Telescope
Binding of Skalnate Pleso Atlas

Periodicals—In addition to Sky and Telescope, there are also available for circulation, The Strolling Astronomer and recent issues of Scientific American.

Total circulation of books: 304; periodicals: 119.

The slides, projector, and screen of the Centre have been in almost continuous use both at our regular observation meetings and by members speaking to outside groups.

CHARLES M. GOOD, *Librarian.*

REPORT OF OBSERVATION COMMITTEE

Activities of the Montreal Centre for 1950 followed closely the pattern set in previous years, and we are pleased to report continued success in numerous fields of observation. Saturday night attendance at Ville-Marie Observatory

reached an all-time high of 1211. The total attendance for the year was 1331, comparing favourably with last year. Amongst the distinguished out-of-town visitors we note Mr. E. R. Gardner, President of the Winnipeg Centre, and Mr. Neal J. Heines, Chairman of the Solar Division of the A.A.V.S.O., Harvard College Observatory.

Following is a list of the main activities of the Centre:

Aurora Borealis—15 observers sent 90 reports covering 48 auroral displays to Miss Williamson, who forwarded these to Cornell University.

Eclipses—30 persons took part in the observation of the total eclipse of the moon on September 25. Work was sharply curtailed due to unfavourable weather conditions and smoke from forest fires.

Meteors—A record total of 466 meteors were plotted during the Perseid meteor shower of August 11-12. 17 members participated in a programme planned by Miss Williamson.

Planets—A series of observations was undertaken on the planet Mars, and drawings were made from March 1 to May 5.

Sun-spots—Messrs. DeKinder, Morgan and Noseworthy effected systematic daily sun-spot observations which were forwarded to Harvard College Observatory. Naked eye sun-spot counts were made by Mrs. Wright and Messrs. Milton and Venor.

Star Nights—Highlights of the year were four major star nights held at Lachine, May 22, Lachute, July 19, Lancaster, July 25, and Westmount Park, October 18. In addition other small star nights were given during the summer months by members of the Centre.

Telescope Making—The glass pushers have also registered considerable gains under the expert guidance of Mr. Venor. At least 10 members were actively engaged in constructing telescopes.

In other fields we are pleased to report classes conducted and examinations given for Boy Scouts and Girl Guides.

The Astronomical League Convention, held at the beginning of July, was attended by five of our active members: Miss Williamson, Mrs. Wright, Messrs. DeKinder, Good and Patterson.

The Messier Club now boasts 33 members in search of the 104 nebulae and star clusters of Messier's catalogue. The Asteroid Club for juvenile members is also progressing with eight students enlisted, and three graduating.

DeLisle Garneau.

London Centre

Seven regular meetings were held during the year and on October 27 was celebrated the tenth anniversary of the founding of the Cronyn Memorial Observatory of the University of Western Ontario.

Subjects and speakers were as follows:

January 20,—H. R. Kingston: "The Earth as an Astronomical Body"; G. R. Magee: Demonstration of the Motor Planetarium and Planeto Zodiac; Rev. W. G. Colgrove: "Constellation Study".

February 17,—G. R. Magee: "Solar Family" with film movie; W. G. Colgrove: "Constellation Study."

March 17,—H. R. Kingston: "The Moon, our Nearest Heavenly Body or Neighbour"; G. R. Magee: "Constellation Study."

April 21,—H. R. Kingston: "The Moon" continuation of March subject; R. H. Cole: "Comets and Meteors"; Mrs. B. M. Johnson: "Constellation Study".

May 19,—E. E. O'Connor: "The Planet Mars"; G. W. Waldon: "The Planet Saturn"; W. G. Colgrove: "Constellation Study".

October 27,—Tenth Anniversary Celebration. H. R. Kingston: "Founding of Cronyn Memorial Observatory"; A. E. Johns: "Eclipses and Transits."

November 17,—A. D. Misener: "Interstellar Space in the Laboratory"; W. G. Colgrove: "Constellation Study."

December 15,—J. H. Wake: "North of the Arctic Circle." Election of officers and lunch followed the lecture.

R. E. WINTERS, *Secretary.*

EDMONTON CENTRE

All regular meetings have been held in the Arts Building through the kindness of the University authorities. The attendance varied from 23 to 55, with an aggregate of 265. This is three less than last year. The Handbook talks were given by Dr. Campbell. News comments, partly from the Montreal "Skyward", were given by Mr. Burt.

The main papers have been as follows:

December,—J. A. Harle: "The Engineer and Astronomy."
January,—H. Jordan: "Orbital Motion."
February,—J. J. Gillis: "Solar and Cosmic Radio Noise."
March,—L. Gads: "Time Finders and Time Keepers."
April,—S./L. W. A. Hockney: "Polar Navigation."
May,—J. W. Campbell: "The Scale of the Universe."
October,—S. G. Deane: "Many Moons."
November,—D. B. Scott: "Worlds in Collision."

The roll of the Centre now consists of 58 members including two associates.

E. H. GOWAN, *Honorary Secretary.*

Centre de Québec

En raison de l'absence du secrétaire, actuellement en stage d'étude, trois réunions générales seulement ont été tenues au cours de l'année:

Le 8 février,—Alberic Boivin: "Aurores Polaires," réunion conjointe de la Société de Mathématiques.

Le 5 juillet,—Réunion générale pour l'élection du Bureau en office durant l'année 1950-51. Tenue à l'Observatoire.

Le 25 novembre,—Chs.-A. Giroux, météorologiste à l'observatoire de Dorval: "Comment Dorval Prévoit."

M. Georges-Etienne Gagné a soumis son rapport sur les coincidences de température pour la quatrième année consécutive. Les chiffres qu'il donne indiquent une tendance à la diminution des coincidences, en général, à mesure que le Soleil s'achemine vers son minimum d'activité.

Notre Chronique hebdomadaire dans le journal *L'Action Catholique* a paru sans interruption, mais nous avons dû adopter une formule nouvelle qui exige une préparation moins longue.

Le Graphique du Ciel de l'Académie des Sciences du Maryland maintient son immense popularité. Nous recevons de nombreuses demandes de la part des amateurs de France, et surtout de professeurs de cosmographie dans les lycées. L'un de ces graphiques grand-format orne, par exemple, le laboratoire de mesure du Collège Classique des Garçons, à Antibes, France. Les demandes pour l'année 1951 ont commencé à arriver avant même que la publication soit annoncée.

En terminant, nous désirons remercier, au nom de tous les amis de notre science, notre généreux mécène, le Gouvernement de la Province, qui nous a permis, une autre année encore, la dixième, de continuer l'oeuvre scientifique et vulgarisatrice qui nous est chère.

Paul-H. Nadeau, *Le secretaire.*

Windsor Centre

The year 1950 finds the Windsor Centre with a total membership of 44, a figure which represents the stability of the local centre.

There were nine regular meetings, one executive meeting, and two council meetings. Through the courtesy of Miss A. Hume, all regular meetings were held at the Willistead Art Gallery.

The Windsor Centre continually strives to provide increased interest in its work, and to this end, announcements were made in the Windsor Star preceding each meeting, and a poster set up in the Willistead Lobby inviting the general public to the meetings.

The Windsor Centre has three telescopes available for loan to any interested party. They consist of one 3-inch refractor, one 6-inch refractor, and a 10-inch reflector telescope.

We regret the loss of one of the Society's greatest friends from the locality, Mrs. M. Back, former President of the Detroit Astronomical Society, who has moved to California due to poor health.

The following is a summary of the speakers and their subject.

January 17,—O. C. Mohler, University of Michigan, Ann Arbor: "Astronomical Fields of Force."

February 21,—Flight Lieutenant Snider, Royal Canadian Air Force, Ottawa: "Mapping Canada"; C. Hallam: "Current Events."

March 21,—E. R. Phelps, Wayne University, Detroit, Michigan: "The Great Eye of Palomar"; Michael Brown: "Study of the Heavens"; C. A. Bell: "Current Events Under the West Indies Sky."

April 18,—L. Aller, University of Michigan, Ann Arbor: "Planetary Nebulae"; J. Evzovitch: "The Interferometer."

May 16,—L. Rogers, C. Montrose, C. Hallam and D. C. Bawtenheimer, Past Presidents of the Centre:"The Last Ten Years in Astronomy."

June 20,—Telescopic observation night; "Poplar Lodge Meeting" at D. C. Bawtenheimer's Poplar Lodge. W. Person: "European Tour."

September 12,—H. R. Kingston, Western University, London: "Riding the Sky with the Sun and Moon"; C. Hallam: "Tape Recording of Dr. H. R. Kingston's Talk."

October 17,—Miss R. J. Northcott, David Dunlap Observatory, Richmond Hill: "Velocities of Stars."

November 21,—C. A. Bell: "Asteroids." Annual Meeting followed.

HENRY LEE, *Secretary.*

SASKATOON CENTRE

The activities of the Saskatoon Centre for 1950 included four general, three executive, and one observational meetings. All general meetings were held at the University Physics Building.

January 12,—W. Petrie: "Reproduction of Auroral Effects in the Laboratory."

February 13,—G. A. McPherson: "Meteorological Optics in Summer and Winter."

March 13,—Dr. Hilpert, artist, showed slides of his paintings of the aurora gathered across Canada in the last 17 years.

November 20,—R. E. Jensen: "The Northern Lights."

G. R. SMALL, *Secretary.*

Guelph Centre

During the year 1950 seven regular meetings were held in the Physics Building of the Ontario Agricultural College. In addition to these meetings there were eight study group meetings held at the homes of some of our members.

Subjects and speakers at the meetings follow:

January 24,—R. C. Moffat: "The Principles and Use of the Spectroscope."

February 9,—The study group was held at the home of Prof. and Mrs. V. C. Lowell.

February 23,—V. C. Lowell: "The Solar System"; R. C. Moffat: "Sunset Colours"; H. Seekins: "Star Photography."

March 9,—The study group was held at the home of Mrs. Barber, MacDonald Hall, O.A.C.

March 23,—H. Seekins: "The Constellation of Orion"; R. C. Moffat: "The Force of Gravity"; W. Patterson: "The Principles of Optics."

April 14,—The study group was held at the home of Prof. and Mrs. R. C. Moffat.

April 27,—Dr. MacNaughton: "The Expanding Universe"; H. Seekins: "The Constellation of Leo."

May 11,—The study group was held at the home of Mrs. G. Currier.

May 25,—V. C. Lowell: "Nearer Stars"; R. C. Moffat: "Static Electricity." This was followed by an observation evening with the telescope of Mr. H. Seekins on the Campus.

June 8,—The study group was held at the home of Mr. and Mrs. H. Seekins, Hespeler. It consisted of a short discussion followed by an observation evening.

July 13,—The study group was held at the home of Mrs. P. Mockford, Marden. The meeting was chiefly devoted to practising meteor observation in preparation for the Perseid shower in August.

August 12, 13,—The study group held meteor observation at the home of Prof. and Mrs. R. C. Moffat. The charted results which were obtained were forwarded to the Dominion Observatory, Ottawa.

October 26,—V. C. Lowell: "A View of the Universe"; R. C. Moffat: "Polarized Light."

November 30,—V. C. Lowell: "The Planets"; H. Seekins: "The Winter Sky."

Stewart G. Bruce, *Secretary.*

Centre Français de Montréal

Le Centre Français de Montréal a tenu 15 réunions générales à compter du mois d'octobre 1949 jusqu'au 31 décembre 1950. Le Conseil s'est réuni six fois, à l'école Polytechnique où la Société bénéficie de multiples avantages comme la bibliothèque, et des salles avec appareils de projection.

En décembre 1949, en collaboration avec l'Institut Franco-Canadien, la Société a reçu, pour la seconde année consécutive, monsieur Valéry Giscard D'Estaing, ingénieur diplômé de l'école Polytechnique de Paris, qui a présenté trois conférences:

Le 7 décembre,—"Notre soleil et les autres."
Le 12 décembre,—"Notre planète et les autres."
Le 14 décembre,—"L'astronomie et les autres sciences."

Le 2 février,—Delisle Garneau: "La manière d'utiliser l'Observer's Handbook."
Le 9 février,—Rév. frère Robert, f.e.c.: "Le graphique du ciel."
Le 16 février,—Delisle Garneau: "La manière d'utiliser l'Observer's Handbook."
Le 28 février,—Rév. frère Robert, f.e.c.: "Les Ecrivains et l'Astronomie."
Le 16 mars,—Visite du Planétarium du Montreal High School, avec explications par M. Delisle Garneau.
Le 30 mars,—Films sur l'Astronomie, à l'école Polytechnique.
Le 20 avril,—Jean Asselin: "Ringuet et l'Astronomie."
Le 25 avril,—Soirée astronomique chez M. Delisle Garneau, à l'observatoire Ville-Marie.
Le 8 juin,—Jean Naubert: "Les Aurores boréales."
Le 11 octobre,—J. Cougnard: "Les soucoupes volantes."
Le 22 novembre,—Delisle Garneau: "Excursion dans le système solaire."

Signalons qu'à l'automne 1950 notre Société a jugé un concours ouvert aux Jeunes Naturalistes. Elle a de même encouragé "Les Amis de la Nature," groupement intéressé à l'astronomie, qui a tenu sa deuxiéme exposition annuelle au Jardin botanique de Montréal.

Le nombre des adhérents a baissé quelque peu, il est actuellement de 41, mais nous espérons le maintenir à l'objectif de 50.

JEAN ASSELIN, *Président.*

FINANCIAL STATEMENT, 1950

I. NATIONAL TREASURER

GENERAL ACCOUNT

Receipts

Balance December 31, 1949		$ 922.63
Grants—Canada	$2,000.00	
—Ontario	500.00	
Fees from Centres	3,389.35	
Fees from General Members	1,074.64	
Subscriptions	440.25	
Observer's Handbooks	928.37	
Premiums and Exchange (Net)	113.66	
Publications	803.81	
Advertising	119.00	
Interest (Life Members' Bonds)	38.61	
At-Home Donation	50.00	9,457.69
		$10,380.32

Disbursements

Publications	$ 6,746.31	
Grants to Centres	1,058.50	
Salary	1,300.00	
Light	12.35	
Rent	480.00	
Library	3.25	
Exchange	11.15	
Office Stamps	200.00	
Office Printing	151.34	
Stencils	26.31	
Annual Meeting and At-Home	174.25	
General	96.68	10,260.14
Balance		$ 120.18

LIFE MEMBERSHIP FUND

Receipts

Bank Balance December 31, 1949	$ 443.61	
Donation	15.00	
Life Members' Fees	120.00	
	$ 578.61	

DISBURSEMENTS

Bond	$ 512.45
Bank Balance December 31, 1950	66.16
	$ 578.61

BUILDING FUND

RECEIPTS

Bank Balance December 31, 1949	$ 973.84
Interest	183.62
	$1,157.46

DISBURSEMENTS

	$ 512.46
Bond	645.00
Bank Balance December 31, 1950	$1,157.46

SOUTHAM PRESS FUND

RECEIPTS

Bank Balance December 31, 1949	$ 337.88
Interest	57.00
	$ 394.88

DISBURSEMENTS

Bond Safekeeping	$ 12.45
Medals	45.45
Bank Balance December 31, 1950	336.98
	$ 394.88

BONDS AND DEBENTURES HELD BY R.A.S.C. AT IMPERIAL BANK

Account	Brought fwd.	Purchased	On hand	Yearly interest
Life Members' Fund	$1,300.00	$ 500.00	$1,800.00	$ 38.61
Building Fund	6,200.00	500.00	6,700.00	183.61
Southam Press Fund	1,950.00		1,950.00	57.00
	$9,450.00	$1000.00	$10,450.00	$279.23

J. H. HORNING, *National Treasurer.*

II. REPORTS OF TREASURERS OF CENTRES

TORONTO CENTRE

Receipts		Disbursements	
Balance from 1949	$398.07	Rentals	$ 37.70
Grant from National Council	166.50	Postage, stationery, printing	73.48
		Donation to National Society	50.00
		Hamilton Centre re film	15.00
		Expenses re meetings	2.50
		Balance	$385.89
Totals	$564.57		$564.57

Special Purpose Account

Receipts		Disbursements	
Balance carried forward	$474.53	Books for Library	$ 21.05
Fee from Canadian National Exhibition	$150.00	Insurance (Exhibition)	9.00
		Express (Exhibition)	8.30
		Balance	586.18
Totals	$624.53		$624.53

T. H. Mason, *Treasurer.*

OTTAWA CENTRE

Receipts		Disbursements	
Balance from 1949	$ 23.80	Fees to National Treasurer	$243.00
Membership fees: 1949 (5); 1950 (64); 1951 (12)	243.00	Expenses re meetings	223.35
Grant from National Council	75.00	Postage	13.86
Share of At-Home	45.00	Printing	7.67
Donation	10.00	Stationery	7.20
Bank interest	.38	Exchange on cheques etc.	1.25
Sale of 1950 Handbooks	46.80	1950 Handbooks (20)	6.40
Proceeds of Annual Dinner	136.50	1951 Handbooks (100)	32.00
Miscellaneous	.08	Balance carried forward	45.83
Totals	$580.56		$580.56

S. A. Mott, *Treasurer.*

HAMILTON CENTRE

Receipts		Disbursements	
Balance from 1949	$ 37.32	Rent	$ 45.00
Membership Fees	225.00	Fees to National Treasurer	147.00
Grant from National Council	52.00	Stationery	6.00
Donations	10.76	Postage	10.52
Proceeds from Field Night	100.70	Printing	14.85
Sale of books	6.68	Expense re meetings	69.88
Bank interest	.72	Exchange on cheques	.15
		Balance carried forward	139.78
Totals	$433.18		$433.18

GEORGE MURCHIE, *Treasurer.*

WINNIPEG CENTRE

Receipts		Disbursements	
Balance from 1949	$ 99.49	Fees to National Treasurer	$ 63.00
Membership fees	90.00	Printing and postage	12.14
Grant from National Council	29.00	Expense re meetings	3.00
Bank Interest		Balance carried forward	141.06
Totals	$219.20		$219.20

MARGARET E. WATTERSON, *Treasurer.*

VICTORIA CENTRE

Receipts		Disbursements	
Balance from 1949	$300.11	Annual Dinner deficit	$ 16.74
Membership fees	228.00	Fees to National Council	206.00
Grant from National Council	116.00	Rent	32.75
Bond	50.50	Speaker and film	47.41
Interest	4.83	Exchange	1.15
Summer course profit	38.60	Subscription	3.99
Door collections	19.50	Printing and paper	20.03
		Insurance	19.78
		Stationery and postage	3.23
		Express	5.10
		Cups	.93
		Balance carried forward	400.43
Totals	$757.54		$757.54

The following is a list of the Centre's assets, with an estimate of the present value of the property:

Dome building	500.00
"Reid" 8-inch telescope and accessories	150.00
"Brydon" mounting	25.00
Lantern and screen	110.00
Library books and cases	275.00
"Wray" telescope and accessories	400.00
Mounting for Moore telescope	100.00
	$1360.00

ELUNED WILLIAMS, *Treasurer*

MONTREAL CENTRE

RECEIPTS		DISBURSEMENTS	
Balance from 1949	$ 199.63	Rent	$ 83.00
Membership fees: 1950 (230)		Fees to National Treasurer	696.00
1951 (2)	696.00	Stationery	53.16
Donations:		Postage	71.10
Library	16.00	Library	40.02
Equipment	17.00	Expenses re meetings	48.66
General	96.62	Miscellaneous	.90
Grant from National Council	255.00	Exchange on cheques	1.05
Bank interest	2.84	Equipment	66.07
		Insurance on Library	10.00
		Star Night, on account	7.35
		Balance carried forward	205.78
Totals	$1283.09		$1283.09

C. N. S. YARNELL, *Treasurer.*

LONDON CENTRE

RECEIPTS		DISBURSEMENTS	
Balance from 1949	$175.01	Fees to National Treasurer	$224.00
Membership fees	153.00	Postage	1.34
Grant from National Council	39.00	Printing	9.84
Bank interest	.69	Expense re meetings	38.35
Donations	5.55	Exchange on cheques	.50
		Balance carried forward	99.22
Totals	$373.25		$373.25

R. E. WINTERS, *Treasurer.*

VANCOUVER CENTRE

Receipts		Disbursements	
Balance from 1949	$ 1.03	Two members pd. Toronto	$ 5.50
Membership fees	123.00	Fees to National Treasurer	123.00
Grant from National Council	46.00	Stationery	6.78
Donations	2.70	Postage	5.35
Bank interest	.33	Expense re meetings	12.20
Profit from maps	2.25	Exchange on cheques	.15
Two members pd. Toronto	5.50	Miscellaneous	3.69
		Balance carried forward	24.14
Totals	$180.81		$180.81

C. A. Rogers, *Treasurer.*

EDMONTON CENTRE

Receipts		Disbursements	
Balance from 1949	$ 70.44	Books	$ 14.87
Membership fees	150.00	Miscellaneous	2.13
Grant from National Council	58.85	Stationery and postage	16.00
Bank interest	1.15	Expense re meetings	21.17
Associates' fees	1.50	Fees to National Treasurer	144.00
		Balance carried forward	83.77
Totals	$281.94		$281.94

A. M. P. Smith, *Treasurer.*

CENTRE DE QUEBEC

Recettes		Debourses	
Solde au décembre 1949	$144.30	Cotisations R.A.S.C.	$165.00
Octroi R.A.S.C.	39.00	Administration	102.48
Dons	125.64	Observatoire	114.80
Cotisations	174.12	Réunions	20.00
Emprunt	71.77	Timbres-poste	51.05
Ventes	4.50	Remise au Comité du Télescope	125.64
Intérêt de banque	.80	Solde en banque au 9 décembre 1950	5.16
Totale	$584.13		$584.13

Fonds de Reserve

Comité du Télescope $1232.00

Paul H. Nadeau, *le Trésorier.*

WINDSOR CENTRE

Receipts		Disbursements	
Balance from 1949	$ 29.31	Fees to National Treasurer	$137.00
Membership fees	131.00	Stationery	.90
Grant from National Council	45.00	Postage and film rental	4.95
Bank interest	.31	Expense re meetings	58.30
Premium on U.S. funds	.30	Exchange on cheques	.30
		Miscellaneous	3.40
		Balance carried forward	1.07
Totals	$205.92		$205.92

D. Geauvreau, *Treasurer.*

SASKATOON CENTRE

Receipts		Disbursements	
Balance from 1949	$ 33.85	Fees to National treasurer	$ 54.85
Membership fees	21.00	Postage	1.65
Grant from National Council	36.00	Exchange on cheques	.15
Bank interest	.32	Balance carried forward	34.52
Totals	$ 91.17		$ 91.17

R. E. Jensen, *Treasurer.*

CENTRE FRANCAIS DE MONTREAL

Receipts		Disbursements	
Balance from 1949	$ 27.93	Fees to National Treasurer	$120.00
Membership fees	120.00	Stationery	3.18
Grant from National Council	47.00	Postage	6.82
Donations	8.00	Expense re meetings	20.00
Profits on sale of books	1.00	Miscellaneous	12.10
Interest	.71	Balance carried forward	42.54
Totals	$204.64		$204.64

Roger Bonin, *Treasurer.*

The Royal Astronomical Society of Canada

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OUT OF OLD BOOKS

By Helen Sawyer Hogg

Le Gentil and the Transits of Venus, 1761 and 1769

(cont'd from January-February issue)

Le Gentil had arrived at Manila August 10, 1766, all ready to begin his preparations for the transit of 1769. After some months there, however, doubt began to assail him that this was the best place for his observation. The circumstance which finally decided him to leave the Philippines and go to Pondicherry to observe the transit was the attitude of the Spanish governor. The governor was not kindly disposed to the French, and actually was such a tyrannical character that two years after Le Gentil's departure he was arrested, and died in prison.

Before leaving the Isle de France May 1, 1766, Le Gentil had written to France for letters of recommendation from the Court of Spain to the governor of the Philippines, since in these islands he would be venturing upon foreign soil and possible hostility. When on July 10, 1767, Le Gentil received replies from France to his letter and showed them to the governor, the latter said that a year and two months was too short a time for a reply to be received from France, and that therefore the letters must be forgeries!

> July 10, 1767, I received an answer to the letters which I had written to France the preceding year, 1766, before my departure from the Isle de France; these new letters came through Mexico and Acapulco in the galleon the Saint Charles. I was told of letters of recommendation from the Court of Spain. M. le duc de Chaulnes, with the consent of M. le duc de la Vrilliere, took all necessary steps so that the matter would not languish. My letter found the illustrious M. Clairaut dead; M. de la Lande did not neglect taking an interest in this new enterprise. It was not possible to expect more speed by sea; there was not a single moment lost; hence the governor of Manila, to whom I showed them, a restless man, of evil intentions to the French in general, regarded me in Manila with a jealous eye, collected the times of all my letters and of my departure from the Isle de France, those of the departure of M. de Caseins from Manila. He made a combination of all these times and he concluded that I could not yet have received any answer to my letters, and that those which I had shown him were necessarily forgeries. . . .
>
> This odious and injurious suspicion caused me a good deal of sorrow, and gave me also some worry for the rest of the time which I had still to remain in Manila.

. . . M. de la Lande pointed out to me at the end of his letter that M. Pingré had read at the Academy a memoir in which he complained that I was going too far: he would have wanted me to return to Pondicherry; to the others it was all the same, according to M. de la Lande, whether I remained at Manila or whether I returned to Pondicherry and he told me that I could decide as I wished. I had a great deal of time before me to make up my mind again and to go to the coast of Coromandel.

When I had reflected well and calculated the inconveniences of the two coasts I decided to leave for Pondicherry. The climate of Manila was the only thing which swayed me a little. . . . I considered, I said, that I was running very great risks by staying at Manila; that I was exposing myself not only to the risks of cloudy weather on the day of my observation, but also to the caprice of him who governed. I saw that the governor acted despotically and tyrannically in everything; I saw that, in this distant country, reasons would not be lacking to arrest a man in the course of the most serious and important affairs; I had very striking examples of this before my eyes which would be too long to relate here. . . .

I decided to go in search of a free country since I could choose to do so. Sea voyages no longer cost me anything, I had become so familiar with this element. I wrote to M. le duc de Chaulnes and to M. de la Lande that I should be at Pondicherry in time for the transit of Venus; . . .

When these preparations were finished I used the opportunity of a Portuguese ship from Macao: this vessel had come from Madras and it was returning there. We sailed February 2, 1768, at six o'clock in the evening by a little breeze from the south-east; but our vessel, badly loaded, could not go two leagues without furling the sails; it even went down quite considerably although having only its four lower sails; and although the wind was quite good we were obliged to put about and to go back and anchor at Manila.

Three days later this vessel again got under way, and Le Gentil had a good journey on it, reaching Malacca February 18th and Pondicherry itself after only thirty-two days' sailing. In a long letter to his friend Don Estevan y Melo, Le Gentil writes more fully about the actual happenings aboard ship than he does in other parts of the volume, and we reprint two of these incidents which give a vivid idea of sailing ships in those days.

We therefore sailed as you know February the 5th on the Saint Antoine, and I was on it by the grace of God so to speak, on a ship rather badly ballasted, and which had neither surgeon nor chaplain. We were at first led by a little breeze from the east, by which we passed the isle of Corregidor during the night. . . . Here I shall praise to you the vessel on which I was. For a ship built at Surate by Marates or Malabar Indians, that is to say, by people who do not understand the construction of the Europeans (they do not even bother themselves with it at all), it had very good qualities. It was a fine flute of about 500 tons, very well and very solidly constructed, but without having the grace which our new builders give to ours.

We arrived at la Viole at seven-thirty in the evening; it was night, the weather was not very clear, and the moon in its course did not lend us its light: we were between two equally redoubtable dangers: one is la Viole, the other a sand bank, on which there are several trees and which is not farther than a league and a half from la Viole. It was necessary to pass between the two, and it was night. I shall confess here to you that I was a little worried; not precisely because of the spot in which we were, because the passage which some sailors consider perilous is not so to every sailor; but in connection with a little dispute which arose between the captain and the first pilot.

To recount the affair to you exactly, you will suppose in the first place that in the ships of Macao the captains understand navigation not at all or very little; the first pilot alone is in charge of guiding the vessel, the captain must not meddle in it in any manner, he is only a figure-head in this regard; everything else depends on him. Unhappily for us our captain and our first pilot did not agree very well; it was this which was the cause of the little story which you are going to hear.

We were scarcely through la Viole when the captain cried from above the poop where he was, to the first pilot to make a manoeuver (I do not remember what) of which the latter did not approve; the pilot answered rather brusquely that he would not do it, alleging that he was in charge of the conduct of the ship, that he knew what he had to do, and how it was necessary to navigate. The captain insisted, wanting, he said, to be obeyed. The pilot kept answering him in the same tone: finally the dispute became heated; the latter went into a passion and went and locked himself in his cabin, abandoning his ship to the pleasure of the wind.

I was on the poop taking the air with the captain when this scene took place. As our two men had spoken very quickly as is the custom in all disputes, and as I was not familiar enough with Portuguese, since moreover I was far from the pilot who was on the castle, I had lost a good deal of what was said; and I did not know the decision which our pilot had made. The captain did not stir from his place: so that I did not know the danger which we could run. I went down on the castle a moment after the scene; I looked for the pilot, I did not find him; I went to his cabin, he was in it but he was sulking, and nothing that I could say to him was capable of making him take up the helm again.

I went to find the Armenians and especially the supercargo, as they had a personal interest in the ship because they had freight and because it was returning loaded with piastres for their reckonings, I did not doubt that they would bring my man back to reason.

However, the ship kept on advancing. I took over here for the first time the office of pilot: while the Armenians flew to the cabin where he was and while they were entreating him, I went to the tiller to see if the steersman were not going away from his course.

The Armenians had frightful difficulty in getting the pilot out of his cabin; but when the Seigneur Melchisedek, with that great phlegmatic air which you know in him, had spoken to him about conscience, he finally succeeded in conquering his obstinacy. "*Hombre*", he said to him, (from what he told me a moment afterwards), "*tiene usted conscientia?*" "Are you a man who has any conscience?" He submitted at this word conscience, coming from the mouth of an Armenian,

and he resumed the conduct of the vessel. This pilot was a brusque and gross man, he became moody easily; otherwise it appeared to me that he understood this sort of voyage very well.

Near the coast of Malay and Pol Pinang the following incident occurred:

Our two first pilots and a passenger had gone to land in the ship's boat, incited by curiosity to see the island. They tried to get me to go to land with them; but my policy is never to quit my ship unless it is in a port or in a sure roads; although it was very fine weather when they descended, they could not persuade me to decide to go with them. How thankful I was for my resistance when I saw the bad weather and when I perceived all the horror of the condition to which the travellers were reduced! They had astonishing trouble in getting back on board ship: twice they arrived to take the route back from the island; it was darkest night, and there was a very heavy rain; they were led only by the waves of the sea which appeared all on fire. Finally the desire to sleep on board ship rather than pass the night on land without any shelter made them make a vigorous effort a third time. They finally gained shipboard at eight o'clock in the evening; we heard them a long time before seeing them; they shouted to us to throw them a mooring rope. Their repeated cries in the middle of the night, the bad weather, the noise of the sea, the efforts which they were making to come alongside, all that represented for me the picture of shipwrecked people. . . .

You see by this tale what Portuguese vessels are. I have never heard of a European vessel anchored in an open roadstead, in which there was so little discipline that the two first pilots could thus abandon their ship for a pleasure jaunt. Only the captain remained, and he was as little in condition to conduct his vessel as I am to lead an army, and for pilots, two old automatons to whom I would not have entrusted the conduct of a launch.

In spite of these somewhat harrowing experiences, Le Gentil considered his trip an excellent one, and concludes his account of the trip by saying:

It is not possible to have a more fortunate voyage than that. You will see by recapitulating all the dates reported in this letter that we took only thirty-two days sailing to go from Manila to the coast of Nagpatnam although we left Manila late: this passage is one of the finest which has been seen for a long time. As to the manner in which I was treated aboard the ship, the Saint Antoine, I cannot complain of it since the captain treated me as himself.

(*To be continued*)

NOTES AND QUERIES

An Interesting Astronomical Device

Mr. C. J. Fensom of 34 Mountwood Avenue, Hamilton, who is a retired engineer, has constructed an interesting device to help him study the heavens. It consists of a disk with sighting projections at angles corresponding to the positions of the brighter circumpolar stars. The disk may be tilted and turned so that the projections point to the proper stars. Graduated circles then enable Mr. Fensom to read latitude and sidereal time.

J. F. H.

Chubb Crater, Ungava

Attention continues to be focused on the meteor crater in Ungava which was investigated last summer by Prof. V. B. Meen and Mr. Fred Chubb and their party (see this Journal, vol. 44, p. 169, 1950). Dr. Harlow Shapley in his annual list of the ten astronomical highlights of 1950 has given this first place, and Mr. K. W. MacTaggart, for his reporting of the expedition, has won the National Newspaper Award for the best on-the-spot reporting of a news story.

Ralph B. Baldwin in his recent book, "The Face of the Moon" (University of Chicago Press) has shown that terrestrial explosion craters, meteor craters and lunar craters all obey a law relating rim height and diameter of the crater; from this he concludes that all these craters have explosive origin. Baldwin's formula is

$$E = -0.087\,D^2 + 1.542\,D - 1.841,$$

where E = log rim height in feet, and D = log diameter in feet. It is interesting to notice that the diameter of 11,000 feet and the mean rim height of 440 feet, as given by Prof. Meen for the Ungava Crater, fit this relation very well. The Ungava Crater is larger than the largest meteor craters and larger than the smallest lunar craters which Baldwin has used in establishing the relation.

J. F. H.

MEETINGS OF THE SOCIETY

AT WINNIPEG

January 11, 1950.—The regular meeting of the society was held in Theatre B. Univ. of Man., Broadway Bldg., with the President, Mr. H. E. Rasmussen, in the chair. Mr. Rasmussen referred to the correspondence with the Winnipeg School Board, dealing with the Society's proposal that an observatory dome be installed in the new Technical School on Notre Dame Ave. This proposal was to be discussed by the Building Committee of the School Board on January 12. A committee consisting of Mr. E. R. Gardner and Mr. A. T. S. Norris-Elye was asked to represent the Society at this meeting. Two new members, proposed at a previous meeting, were elected to the Society: Mr. V. G. Martin, 886 Grain Exchange; Mr. T. J. Reichert, 886 Grain Exchange.

The speaker of the evening was Mr. H. E. Rasmussen with a lecture entitled "Time and Its Measurement". He commenced by stressing the importance of accurate time keeping in this modern age. In navigation it is indispensable. As the age of discovery progressed, the governments of the sea-faring nations offered substantial rewards for new or improved methods of time keeping. This had a stimulating effect to new invention. Mr. Rasmussen traced the technical development of clocks through all its stages, from the primitive water clocks of the twelfth century to the crystal and electronic clocks of today. With slides and blackboard demonstrations, he explained the principles involved in the functions of these clocks. Members and visitors found this lecture very interesting and informative. The meeting adjourned at 9.30 p.m. and was followed by the annual meeting of the Society.

April 13, 1950.—The regular meeting was held in the Broadway Building, University of Manitoba, with President E. R. Gardner in the chair.

He announced that the Winnipeg School Board had rejected the Society's plan for an observatory at the new Technical School. However, other ways would be sought to realize the Society's ambition to possess an observatory.

Mr. Gardner announced with regret that Mr. G. P. Morse, a member of long standing, had recently passed away. Mr. L. T. S. Norris-Elye, a close acquaintance of the late Mr. Morse, stated that Mr. Morse was an engineer and mathematician of some repute and had played an active role in this Society. He asked that a minute's silence be observed and that a letter of condolence be sent to Mrs. Morse.

Mr. Gardner announced that the speaker was Mr. H. E. Rasmussen of Hal-Ross Instruments, and that his lecture would deal with "Astrophysics".

Mr. Rasmussen first gave an evaluation of man's relation to his environment. Nature had endowed man with the ability to interpret his surroundings through the medium of light. In his primitive state, man took this natural sense for granted and found it sufficient for his daily use. With the coming of the philosophers, however, it soon became necessary to seek through physical experiment to verify or reject their speculations. The speaker showed slides illustrating different

methods of gathering light by means of refracting and reflecting telescopes. He then demonstrated the necessity for extreme accuracy in the figuring of these optics. He showed that most mirrors of reflecting telescopes are parabolic. The Schmidt camera, however, has a spherical mirror with a thin plate glass of variable thickness in front to give it a parabolic effect. This telescope has a large field of view. Mr. Rasmussen then showed how light can be analyzed with a spectroscope, to reveal the nature of the matter at its source. With analyses of spectra produced by passing light through this instrument, it is possible to determine the movements of the heavenly bodies by utilizing the Doppler effect. He then demonstrated a very sensitive radiation-detection instrument called a scintillometer, and explained the principles involved in its function. A general discussion followed.

Mr. Gardner lead a discussion on the contents of two books entitled "Brewster's Astronomy" and "Worlds in Collision". These books are highly controversial and many interesting comments were made.

October 11, 1950.—The regular meeting of the Winnipeg Centre was held in Convocation Hall, United College, with the President, Mr. E. R. Gardner, in the chair. Approximately 50 members and guests were present. The lecture, entitled "How to Make a Telescope", was presented by Mr. Gardner, based on his experience in making the 9-inch reflecting telescope which was on display.

Mr. Gardner commenced with the advice that the first step would be to acquire the book entitled "Amateur Telescope Making". He then pointed out that patience was a necessary virtue in this endeavour. In selecting the material for the primary, Mr. Gardner showed that any material which was rigid, had a low coefficient of expansion and could be figured by comparatively simple methods would be suitable. Pyrex is such a material and is used in the majority of reflectors today. With a blackboard illustration, he showed the principles involved in shaping the mirror. He then showed how the mirror is tested for imperfections and proper curvature with the straight edge method. Finally, if the mirror's focal length is less than 9 diameters, it must be parabolized to give satisfactory results. This operation involves precision which is measured in fractions of millionths of an inch. Mr. Gardner explained the method used in aluminizing mirrors, and its advantage over silvering. He then demonstrated his 9-inch reflecting telescope and explained the problems which he had to overcome in its construction. It is equatorially mounted with an electrically operated driving mechanism. Much of this assembly was originally war service equipment.

Next Mr. Gardner reviewed a book entitled "The Planet Mars" by Gerard De Vaucouleurs and translated by Patrick A. Moore.

The President announced with regret that Mr. A. V. Thomas, a society member of long standing and a member of the National Council of the R.A.S.C., had recently passed away. In tribute to the late Mr. Thomas, Mr. Gardner spoke commendably of his active interest in astronomy and his valuable service to this Society. A letter of condolence had been sent to Mrs. Thomas.

J. A. WHITE, *Secretary.*

AT TORONTO

November 28, 1950.—The meeting was held in McLennan Physics Laboratory, the Chairman being Mr. A. R. Clute, President.

There was one transfer from the Ottawa Centre, Miss Margaret A. McKee.

The president introduced the speaker, Dr. Gerhard Herzberg, Director of the Division of Physics of the National Research Council. Dr. Herzberg spoke on "The Atmospheres of the Planets."

Much has been accomplished in this field in the last 20 years, mostly through spectroscopic investigation. Many of the components of the earth's atmosphere have been discovered by chemical analysis although some have been found spectroscopically. Ozone, methane and others have been observed in solar absorption spectra. Emission spectra obtained from aurora, night sky luminescence and twilight flash yield many other components of the atmosphere. The temperature of the upper atmosphere can be estimated by means of the intensity distribution in some molecular bands.

For the other planets a high albedo indicates a dense atmosphere. Infra-red spectra have shown the presence of atmospheric components on various planets, for example, CO_2 on Venus and Mars. Kuiper has shown with his infra-red spectrometer that the Martian polar caps are largely solid H_2O. The absence of refraction effects during occultations of stars shows that the maximum atmosphere for the moon is 10^{-5} terrestrial atmospheres. The temperature of Venus' atmosphere has been shown to be about 300° K. Visible clouds upon Mars and Jupiter indicate the presence of an atmosphere. There is an indication that Saturn's rings show the solid H_2O spectral characteristics and Dr. Herzberg is working on this at present.

The speaker stressed the improbability of there being any high form of life as we know it on the other planets, and said that it was perhaps wiser to study planetary atmospheres in order to find out more about our own atmosphere and the origin and evolution of planetary atmospheres.

The speaker was thanked by Dr. F. S. Hogg

December 12, 1950.—This meeting was held in McLennan Physics Laboratory, the Chairman being Mr. A. R. Clute, President.

Two candidates were nominated for membership in the Society.

Mr. William Hossack gave a talk entitled, "Astronomers' Picture Book." This was illustrated with about one hundred slides.

The meeting was adjourned and followed by the annual business meeting of the Toronto Centre.

December 16, 1950.—A joint meeting was held with the Royal Canadian Institute in Convocation Hall.

Dr. J. F. Heard addressed the meeting on, "Signposts in the Stratosphere." He told the story of modern air navigation, stressing the role which Canada and Canadians play, particularly in polar navigation.

W. R. HOSSACK, *Recorder.*

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